WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Guidance for Assessing and Certifying Tank Systems that Store and Treat Dangerous Waste

June 1994
Publication No. 94-114

Guidance for Assessing and Certifying Tank Systems that Store and Treat Dangerous Waste

Prepared by
Washington State Department of Ecology
Hazardous Waste and Toxics Reduction Program

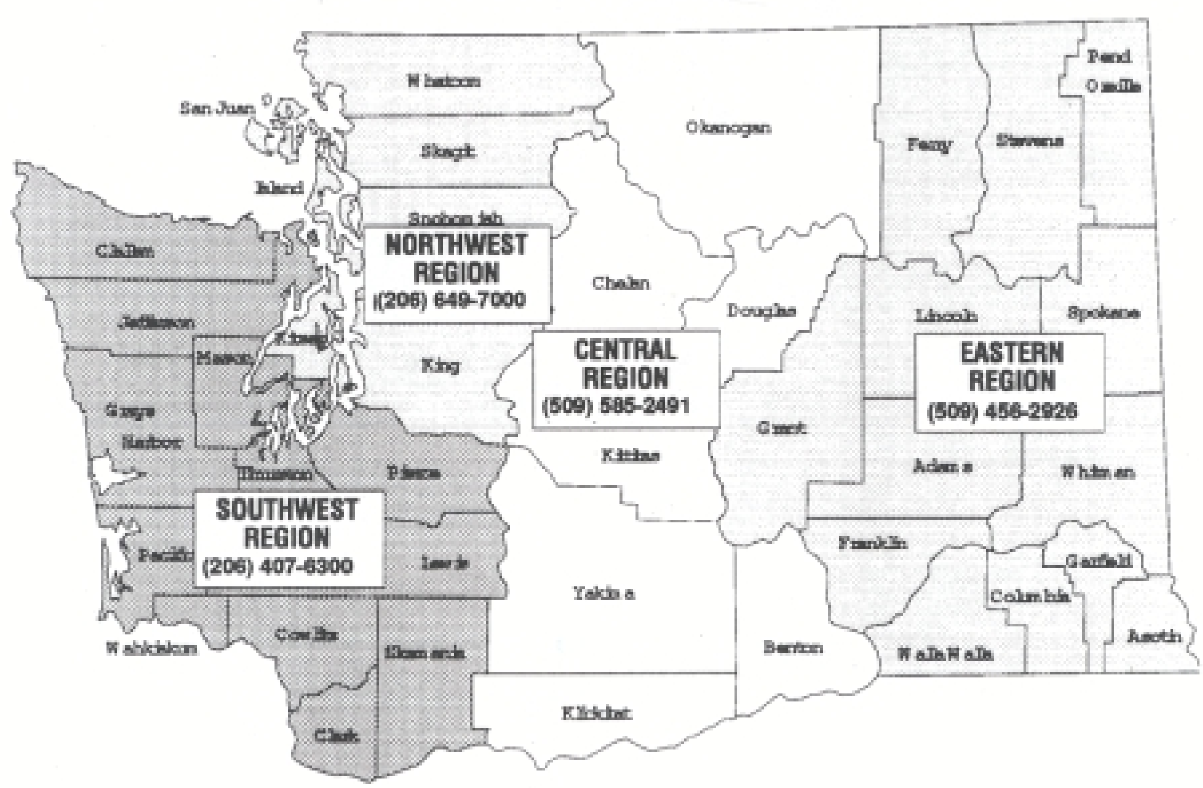
June 1994
Publication No. 94-114

printed on recycled paper

For a copy of this report, please contact
Department of Ecology
Publications
P.O. Box 47600
Olympia, WA 98504-7600

Please include your street address for UPS delivery.

The Hazardous Waste and Toxics Reduction Program is responsible for the management and reduction of hazardous waste and toxic substances in Washington State. We're here to answer your questions. Contact your nearest regional office and ask for a Hazardous Waste Specialist if you are uncertain about your responsibilities as a hazardous waste generator. And for information on reducing or recycling hazardous waste, ask for a Toxics Reduction Specialist.



The Department of Ecology is an Equal Opportunity and Affirmative Action employer and shall not discriminate on the basis of race, creed, color, national origin, sex, marital status, sexual orientation, age, religion or disability as defined by applicable state and/or federal regulations or statutes.

If you have special accommodation needs, please contact Dave Dubreuil at (206) 407-6721 (Voice) or (206) 407-6006 (TDD).

Table of Contents

Chapter 1. Introduction

This guidance has been developed to assist persons conducting and certifying integrity assessments of tank systems which stoke and treat dangerous waste. Ecology staff will use this guidance as the basis for reviewing the adequacy of these integrity assessments which are required by state Dangerous Waste regulations, WAC 173-303. Tank system assessments and accompanying certifications are required for: 1) existing tank systems, 2) design of new tank systems, 3) tank system installations and 4) extensive repairs of existing tank systems.

Tank system integrity assessments may be conducted by any qualified person. However, these integrity assessments must be reviewed and certified by an "independent, qualified, registered professional engineer." Ecology defines "independent, qualified, registered professional engineer" as a person who is registered in Washington, or a state which has reciprocity with the state of Washington, and who is not an employee of the owner or operator of the facility whose tank systems are being assessed (WAC 173-303-040).

"Qualified" professional engineer, with respect to tank system certification, is generally interpreted to mean the professional engineer has training and expertise in tank system design and installation. He or she should be able to recognize signs of past or potential tank system failure during the intended operating life of the tank. This individual should also be able to assess and interpret information on the dangerous waste stored in the tank and the waste compatibility with the materials used for the tank and piping system.

Each assessment report the professional engineer reviews must include a signed, written statement certifying the accuracy, truthfulness and completeness of the material presented and conclusions reached in the report (WAC 173-303-810(13)(a)). The report must be sufficiently detailed to provide a basis for this certification.

Tank Categories

Dangerous waste tank systems consist of the tank itself, a secondary containment system (if required) and ancillary equipment which includes the piping, fittings, flanges, valves and pumps as defined in WAC 173-303-040. There are four categories of tanks storing and treating dangerous wastes: l) aboveground tanks, 2) on-ground tanks, 3) in-ground tanks and 4) underground tanks.

Regulatory requirements and procedures for tanks system closures are discussed in Ecology's Guidance for Clean Closure of Dangerous Waste Facilities. You may obtain a copy of this guidance from your Ecology regional office. For more information, please contact a hazardous waste specialist. A list of telephone numbers and addresses appears at the beginning of this publication.

A tank is classified as an *aboveground* tank if the entire surface area of the tank is above the surrounding ground and its entire surface area, including the tank bottom, can be visually inspected. *A* tank is classified as an *on-ground* tank if it sits directly on the ground so that the bottom of the tank cannot be visually inspected. A tank is classified as an *in-ground* tank if a portion of the tank is below the surrounding ground and cannot be visually inspected. A tank is considered to be an *underground* tank if it is entirely below the ground surface.

This guide has been organized according to the purpose of the tank system assessment.

- Section 2 discusses integrity assessments of existing tank systems and certifications of extensive repairs.
- Section 3 provides guidance for design assessments for new tank systems.
- Section 4 discusses inspection of tank system installations.

Chapter 2. Integrity Assessments of Existing Tank Systems

State dangerous waste regulations require the integrity of existing tank systems storing dangerous waste to be assessed to "determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated to ensure that it will not collapse, rupture or fail" (WAC 173-303-640(2)(c)). Unless otherwise stated, an "existing tank system" in this section of the guidance is a tank system which is currently in use at the time the integrity assessment is being conducted.

Integrity assessments of existing tank systems storing or treating dangerous waste must be initially performed within one year after the waste being stored or treated in the tank system becomes a dangerous waste (WAC 173-303-640(2)(b)). This initial integrity assessment must include a recommended schedule of future tank system integrity assessments "to ensure that the tank retains its structural integrity and will not collapse, rupture or fail." This recommended schedule for future integrity assessments "must be based on the results of the current and past integrity assessments, age of the tank system, materials of construction, characteristics of the waste and any other relevant factors" (WAC 173-303-640(2)(e)).

The professional engineer responsible for certifying the integrity assessment should obtain and review applicable data regarding the tank system. These will include available design plans and as-built drawings, operation and maintenance records, records of daily inspections by facility staff, existing test reports, waste characterization data, inspection records and records of any previous integrity assessments of the tank system.

When available design data indicates a tank was initially designed for a waste with a lesser density than the waste that the tank is currently storing or treating, calculations should be performed to determine the maximum height at which the waste can be stored. The facility owner or operator should be informed of the maximum fill height that can be used for that tank.

2.1 Methods Used to Assess Tank Structural Integrity

The structural integrity of existing tanks storing dangerous wastes can be assessed by performing either leak testing or an external visual inspection in combination with another tank assessment method such as internal visual inspection, ultrasonic, magnetic particle and radiography inspections.

External Visual Inspection: An external visual inspection should be performed to identify any major and obvious deficiencies, such as significant cracking in the tank wall that would require the tank system to be designated as unfit-for-use and taken out of service (see Section 2.6).

When the external visual inspection does not identify any major and obvious deficiencies in a tank system, it should be used in combination with one or more other methods of integrity assessment described below such as ultrasonic, radiographic, liquid penetrant and magnetic particle methods. An external visual inspection cannot be used by itself as a sole method of verifying that a tank system has adequate structural integrity and can continue to remain in use.

American Concrete Institute (ACI) publication 201.1R has photos showing various types of concrete failures.

Items to check for during an external visual inspection include:

- Significant cracks or spalling in concrete pads and concrete secondary containment structures;
- Evidence of excessive or uneven settlement of the tank foundation such as distortion and cracks around anchor bolts attaching a tank to an underlying concrete pad;
- Rust, pitting and other visual evidence of corrosion on the exterior of metal tanks and ancillary equipment, especially at grade level, roof areas and connections;
- Evidence of deterioration of exterior coatings such as rust spots and blisters;
- Damage to any insulation being used;
- Evidence of possible leaks around the tank or ancillary equipment such as discoloration of coatings;
- Cracks or evidence of leaks at joints and welds, especially at connections;
- Apparent loss of metal thickness on the tank bottom and sides;
- Cracks on fiberglass tanks;
- Evidence of chemical attack caused by reaction of concrete structures with the waste stored in the tank such as sulfates, acids and alkali-aggregate reactions;
- Evidence of joints on concrete tanks and vaults that are not watertight;
- Condition of tank system coatings and linings including cracks, gaps, swelling, blistering and crinkling.

Use at least one of the methods listed below in combination with external visual inspection to assess the structural integrity of existing tank systems.

An **internal visual inspection** requires that a tank be first emptied and cleaned using various procedures to free it of volatile and toxic materials. The inside of the tank may then be inspected. (American Petroleum Institute Standard 2015 provides guidance for cleaning storage tanks.) This method should also be used in combination with ultrasonic, radiography, liquid penetrant or magnetic particle inspection methods.

Technologies using a remote-controlled video camera have recently been developed providing an alternative to physically entering the tank to conduct an internal inspection. They enable an operator to observe the condition of a tank's interior and to obtain a video record of the inspection.

Ultrasonic equipment generates ultrasonic waves to measure the thickness of the roof, wall and bottom of metal tanks and is used to evaluate the rate of general corrosion when it occurs. Ultrasonic equipment can also be used to determine the location and size of specific defects in the tank's metallic structure and at welds. Since this equipment only needs to be hooked up to the outside of a tank, it can be used without emptying the tank.

Radiography equipment uses either X-rays or gamma radiation to detect cracks and voids in solid materials including piping and other ancillary equipment. Radiography is often used to inspect welds used on repairs. This technique requires a trained operator who takes precautions to avoid excessive exposure to X-rays or gamma rays.

Liquid penetrant methods use penetrant dyes to detect the extent and size of surface cracks on the outside of a tank and cracks in welds that are not observable by visual inspection. The surface is first thoroughly cleaned, often by sandblasting, then the dye is brushed or sprayed on with the excess removed. After a few minutes to allow the dye to penetrate into any cracks, a chemical developer is applied to the surface which is stained by the penetrant dye exposing the extent and size of any defects. This method can be used on tanks and piping constructed of metallic materials and non-metallic materials such as concrete and fiberglass.

The **magnetic particle** method is used to detect surface cracks on metal tanks and surface cracks in welds that are not observable by visual inspection. This method consists of first carefully cleaning the surface, then applying iron particles to the surface. This method does not provide information on crack depth and cannot be used on non-metallic tanks.

Use leak testing methods which minimize waste.

Leak Testing

Leak testing is required for nonenterable underground tanks (WAC 173-303-640(2)(c)(v)(A)) which are not otherwise determined to be unfit-for-use. Leak testing may also be used to assess the structural integrity of aboveground, on-ground and in-ground tanks. Methods for leak testing include using volumetric methods such as tank tightness testing, installing appropriate sensing devices around the exterior of a tank system or using "environmentally neutral" volatile tracer compounds combined with soil gas monitoring techniques.

Although dangerous waste regulations do not specify a performance standard for leak testing, any leak testing method used must account for high water table effects, temperature variations, vapor pockets and tank end deflections (WAC 173-303-640(2)(c)(v)).

2.2 Assessment of Compatibility of Waste to be Stored or Treated

Assessments of existing tank systems must consider the dangerous characteristics of the waste being stored or treated (WAC 173-303-640(2)(c)(ii)). The waste should be compatible with the materials used for the tank and ancillary equipment. In other words, any portion of the tank system that comes into direct contact with the waste being stored or treated, such as the tank shell, piping, lining, fittings, secondary containment, etc., must not deteriorate.

For example, highly corrosive wastes such as bleaches and highly acidic compounds should not be stored or treated in an unlined steel tank and a waste with a high concentration of nitrobenzene should not be stored or treated in a fiberglass tank. Information to assist in determining the compatibility between a tank system and the waste being stored or treated may be obtained from sources such as *Chemical Engineer's Handbook* and manufacturers' specifications.

Any tank or tank system which is determined to be incompatible with the waste being stored or treated should be identified as unfit-for-use and immediately removed from service.

2.3 Ancillary Equipment

A significant cause of releases is failure of ancillary equipment, including failures of piping, pumps, flanges and couplings. The integrity of piping and other ancillary equipment must be assessed using leak testing or another appropriate method such as radiography (WAC 173-360-303(2)(c)(v)(B)). Also check piping connections and penetrations through tanks and secondary containment structures.

2.4 Assessment of Secondary Containment

Secondary containment is required for "new tank systems" and for "existing tank systems" (defined in WAC 173-303-040) as specified in WAC 173-303-640(4). Its purpose is to prevent the release of dangerous waste or dangerous constituents to the environment. When required, secondary containment must consist of either; 1) an external liner, 2) a concrete vault, 3) a double-walled tank, or (4) "an equivalent device" as approved by Ecology (WAC 173-303-640(4)(d)).

Dangerous waste regulations define "tank system" to include the containment system associated with a tank used for storing or treating dangerous waste (WAC 173-303-040). Therefore, a tank system integrity assessment must include an integrity assessment of its associated secondary containment system.

The following items should be evaluated when assessing the integrity of secondary containment on existing tank systems:

External Liners

An external liner consists of an impervious geotextile or other impervious material which provides a barrier to prevent waste released from a tank or ancillary equipment from entering the surrounding environment. Visible portions of external liners should be inspected for abrasions, cracks, punctures and gaps and evidence of chemical deterioration which would allow released liquid from the tank to pass through the liner into the surrounding environment. The liner material must be compatible with the chemical characteristics of the wastes being stored or treated in the tank system (WAC 173-303-640(4)(c)(i)).

Concrete Vaults

The interior and exterior surface of concrete vaults and other concrete structures used for secondary containment should be assessed for cracks, spalls and other conditions which may result in a release to the environment. ACI Publication 201.1R provides guidance and a checklist for assessing the condition of concrete structures and defines the various types of defects in concrete structures. ACI Publication 224.1R discusses various nondestructive testing methods such as using ultrasonic or radiography equipment to determine the presence of cracks and voids and the depth of cracks visible at the surface.

The interior surface of a concrete vault or curbing must be coated with a material that is impervious to and chemically compatible with the waste being stored or treated in the tank (WAC 173-303-640(e)(ii)(D)). All joints must be sealed with a sealant material with these properties.

Double-Walled Tanks

The outer walls of double-walled tanks must be chemically compatible with the waste being stored or treated (WAC 173-303-640(4)(b)(i)). The exterior surface of a double-walled tank should be inspected for cracks, pitting and other evidence of deterioration of the outer wall.

Buildings Used for Secondary Containment

At some facilities, the building surrounding one or more dangerous waste tanks is used to provide secondary containment. This is acceptable provided the building has been constructed to meet all of the requirements common to secondary containment systems. This includes taking measures to prevent run-on or infiltration of precipitation into the building and ensuring that sumps or other containment methods used are large enough to contain 100 percent of the capacity of the largest dangerous waste tank enclosed by the building.

The portion of the building structure which is designated to contain this volume must be coated with an impervious coating chemically compatible with the wastes be stored or treated within the building. Typically, concrete is used to construct this portion of the building and should be assessed in a manner similar to that used for inspecting other concrete structures used for secondary containment.

2.5 Tank System Corrosion Assessment

External corrosion is a significant cause of tank system failures. For this reason dangerous waste regulations require existing corrosion protection measures to be assessed (WAC 173-303-640(2)(c)(iii)). Where corrosion protection measures such as corrosion resistant materials or coatings and/or cathodic protection systems have not been installed on metallic portions of existing tank systems, the need for installing these systems should be assessed. The need for corrosion protection measures is based on the following factors in the environment surrounding the tank system:

- Properties in the soil surrounding the tank system including moisture content, pH, resistivity, structure-to-soil potential, sulfide and chloride content.
- Presence of stray electric currents from nearby electrical equipment using an external power source.
- The presence of nearby underground metal structures.

One method of providing corrosion protection is the use of sacrificial anode cathodic protection systems. When these systems are installed, they should be evaluated within six months after they are initially installed and then annually. This can be done by measuring the voltage between the tank or piping surface and a saturated copper-copper sulfate reference electrode contacting the soil immediately adjacent to the tank or piping. The voltmeter should read at least 0.85 volts if the cathodic protection system is providing adequate corrosion protection (ref. NACE Standard RP-02085).

Another method of providing cathodic protection is an impressed current system. Rectifier output on impressed current systems should be checked every two months. The voltage and current output from the rectifier should be adjusted if needed to ensure there is a continuous and adequate flow of current from the rectifier to the impressed current system. Electrical continuity and isolation should be checked when these features are required as part of the corrosion protection system. These checks should be documented in the operating record of the facility.

In some cases, metallic tank systems have been designed using a corrosion allowance based on an assumed rate of corrosion. In this case, the current thickness of metal tanks should be determined through the use of ultrasonic techniques or another method to verify that the actual corrosion rate and remaining thickness are within design specifications.

2.6 Disposition of Unfit-for-Use Tank Systems

When a tank system is determined to be leaking or otherwise unfit-for-use, it must be immediately removed from service and the facility owner or operator must satisfy the requirements specified in WAC 173-303-640(7) "Response to leaks or spills and disposition of unfit-for-use tank systems". This includes removing the waste from the tank system, removing and disposing any visible contamination of the soil and surface water and reporting to Ecology any release to the environment within 24 hours of its detection.

2.7 Certification of Extensive Repairs

Extensive repairs of leaking or unfit-for-use tank systems, such as installation of an internal liner, must be certified by an independent qualified professional engineer. This certification must be in accordance with WAC 173-303-810(13)(a) and must include a statement that the repaired tank system is capable of handling dangerous wastes without release for the intended life of the system. This certification must be submitted to the appropriate Ecology regional office within seven days after placing the tank system back in service (WAC 173-303-640(7)(0).

2.8 Existing Tank System Integrity Assessment Report

A written report providing the results of the tank system integrity assessment must be prepared by either the independent qualified professional engineer or by another qualified person. This report must then be reviewed and certified by the professional engineer and the certified assessment report given to the facility owner/operator. The assessment report and accompanying certification must be maintained with the operating record and kept accessible at the facility (WAC 173-303-640(2)(a)).

In order to adequately document the results of the integrity assessment and facilitate review by Ecology staff, the assessment report should contain the following items:

1. Site map of the facility showing the location of the tank system within the overall facility.
2. A sketch of the tank system including connected piping and fittings. If there is more than one tank in the system, the individual tanks should be clearly labeled. Locations of specific items inspected should be clearly indicated and cross-referenced in the results of the integrity assessment.
3. Results of the structural integrity assessment including results of leak testing or other methods used to assess tank system structural integrity (See Section 2.1). The results should clearly state whether the tank system has sufficient structural strength and compatibility with the waste being stored or treated to remain in service.
4. An assessment of the wastes to be stored or treated and their compatibility with the tank system (See Section 2.2).
5. An assessment of ancillary equipment including results of leak testing or other methods used for this assessment (see Section 2.3).
6. Results of the secondary containment assessment (see Section 2.4).
7. Results of the tank system corrosion assessment (See Section 2.5).
8. A recommended schedule of future tank system integrity assessments "to ensure that the tank retains its structural integrity and will not collapse, rupture or fail".
9. A statement by the professional engineer certifying the results of the integrity assessment. This certification must be according to WAC 173-303-810(13)(a) and the professional engineer's signature and stamp must be placed below the certification statement.

Chapter 3: Design Assessments for New Tank Systems

This section applies to design assessments for new tank systems that are to be constructed for storing or treating dangerous wastes. A listing and brief description of industry standards and recommended practice codes, portions of which are applicable to design assessments of new dangerous waste tank systems, is provided in Appendix A.

3.1 Tank Structural Assessment

An independent qualified professional engineer registered in Washington must certify that the proposed tank system will have sufficient structural integrity and is acceptable for storing and treating dangerous waste (WAC 173-303(3)(a)). Dangerous waste regulations require this assessment to "show that the foundation, structural support, seams, connections and pressure controls (if applicable) are adequately designed and that the tank system has sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that it will not collapse, rupture or fail" (WAC 173-303-640(3)(a)).

Design Standards

The structural design standards and criteria used should be clearly and specifically referenced to applicable industry standards and recommended practice codes. Design criteria that apply to a specific tank or group of tanks should be clearly indicated.

Structural Calculations

Structural calculations should be provided for nonstandard “off-specification” or field-assembled tanks. Structural calculations for standard, shop- fabricated tanks are required if the waste to be stored or treated is outside the limitations covered by the manufacturer's specifications.

For example, if the specific gravity of the waste being stored or treated is greater than the maximum value specified in the manufacturer's specifications, structural calculations must be performed to determine the required increase in shell thickness. Otherwise, the maximum height of liquid to be stored or treated in the tank must be restricted to a level calculated based on the specific gravity of the waste.

The tank shell should generally be designed based on a full tank. Calculations should account for liquid specific gravity, external hydrostatic pressure and variables such as internal vapor pressure and vehicle loading, where applicable. The initially computed shell thickness might also need to be increased to account for an assumed corrosion rate (see Section 3.6).

Design parameters used in structural calculations should be clearly indicated and labeled on clarifying sketches. Seismic considerations which are appropriate to the seismic risk zone in which the facility is located should be accounted for in the structural calculations.

The foundation underlying the tank system must support the load of a full tank (WAC 173-303-640(3)(a)(v)(A)) plus the secondary containment structure. This includes the weight of the secondary containment structure plus the liquid volume of the largest tank and precipitation from a 25 year storm of 24 hours duration. It must be designed to prevent failure due to settlement, compression and uplift (WAC 173-303(4)(c)(II). Design plans should require that homogenous, porous, noncorrosive backfill material be placed below and around tank system foundations and underground piping to provide uniform structural support and prevent excessive settlement.

Tank systems must be anchored to prevent excessive displacement (and overturning) when they are located less than 500 feet from an earthquake fault (WAC 173-303-640(3)(a)(v))(B)). Underground or in ground tanks must be anchored to prevent flotation when installed in saturated zones or in areas subject to flooding. Tank systems storing or treating dangerous waste must also be designed to withstand the effects of frost heave (WAC 173-303-640(3)(a)(v)(C)).

When determining the location of a new tank system, apply the criteria for siting new facilities and expanding existing facilities (WAC 173-303-282).

Extensive information on structural design criteria for steel tanks, including design criteria for foundations, is included in American Petroleum Institute (API) Standards 620 and 650. Design criteria for concrete tanks is provided in American Concrete Institute (ACI) Publication 350R.

3.2 Compatibility of Waste to be Stored or Treated

The tank system must be compatible with the wastes which will be stored or treated (WAC 173-303-640(3)(a)). Dangerous wastes or treatment reagents must not be placed in a tank system if they can cause the tank system to rupture, leak, corrode or otherwise fail (WAC 173-303-640(5)(a).

The design assessment must show that the characteristics of the waste to be stored or treated are compatible with the material properties of the tank system including material properties of any interior lining used. Information on protective measures to prevent chemical attack on concrete structures is contained in the Portland Cement Association publication *Effects of Substances on Concrete and Guide to Protective Treatments.*

3.3 Pressure Control Systems

The tank system assessment must show that the pressure control system, if needed, is adequately designed (WAC 173-303-640(3)(a). Pressure control systems are used to control excessive buildup of pressure within a tank. This is often caused by vapors which are created by temperature effects or by adding additional liquid waste into a tank. Internal vapor pressure must be maintained below the tank's design pressure.

Types of pressure control used on dangerous waste tank systems include pressure-vacuum valves, pressure relief valves, pilot-operated relief valves and open vents. The type of pressure controls used should be appropriate to the application. Design criteria for tank pressure control systems is provided in API Standard 2000 and NFPA 30. The following items should be considered when assessing a tank pressure control system:

- Tank capacity and design pressure.
- The flashpoint and other applicable characteristics of the waste to be stored.
- Maximum inflow and outflow rates.
- The type of roof and how it is attached to the tank.
- Locations of pressure relief vents and other pressure controls.
- The pressure control system discharge location(s) (flammable vapors must be released away from any obstruction and at a sufficient height to prevent accidental ignition).

Contact the appropriate air pollution authority to verify that the discharge location complies with applicable air pollution regulations. A list of air pollution authority telephone numbers and addresses appears in Appendix B.

Tank systems which store or treat extremely hazardous waste (EHW) which is acutely or chronically toxic by inhalation must be designed to prevent escape of vapors, fumes, or other emissions into the air (WAC 173-303-640(5)(e)). The assessment of pressure control systems for these systems should include the design plans and data used to design the required emission control devices.

3.4 Assessment of Secondary Containment

Secondary containment for tank systems typically include an external liner, vault or double-walled tank. When required, piping secondary containment systems consist of trench liners, jackets or double-walled piping.

Requirements Common to All Secondary Containment Systems: All secondary containment systems must be designed to meet the following requirements (WAC 173-303-640(4)(b):

- Must prevent any migration of wastes or accumulated liquid out of the secondary containment system to the surrounding environment at any time during the operating life of the tank system.
- Must be capable of detecting and collecting releases and accumulated liquids until the collected material is removed.
- Must be constructed of a material that is compatible with the waste to be placed in the tank system.
- Must have sufficient strength to withstand stresses from static head during a release, climatic conditions, nearby vehicle traffic and other stresses resulting from daily operations.
- Must be placed on a foundation or base that will support the secondary containment system and prevent failure due to excessive settlement, compression or uplift.
- Must be provided with a leak detection system that will detect the failure of either the primary or secondary containment structure or the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within 24 hours (or at the earliest practicable time if the owner or operator can demonstrate to Ecology that existing leak detection technologies or site conditions will not allow detection of a release within 24 hours.
- Must be sloped or otherwise designed to drain and remove liquids resulting from leaks, spills or precipitation.

Typical construction details for detecting leaks through the bottom of aboveground storage tanks are shown in Appendix I of API Publication 650.

Daily visual monitoring by the facility owner/ operator is acceptable for aboveground tank systems and those portions of on-ground and in-ground tank systems which can be visually inspected on a daily basis.

External Liners

External liners are often placed in diked areas and in piping trenches to contain any release from the tank(s) or ancillary equipment. An external liner system must be designed to meet the following additional requirements:

- Must be capable of preventing lateral as well as vertical movement of a release into the surrounding soil.
- Must be free or cracks or gaps.
- Must be capable of containing a release volume equal to the capacity of the largest tank within its boundary.
- Must be designed to prevent run-on or infiltration of precipitation inside the liner or be provided with additional volume to contain precipitation from a 25-year, 24-hour storm.

Vaults

Concrete vault and other concrete structures used for secondary containment are generally designed to allow a visual inspection of the primary tank for leaks. They must be designed to meet the following additional requirements:

- Must be provided with an impermeable interior coating or lining which is chemically compatible with the waste to be contained and that will prevent the stored waste from migrating into the concrete if a release occurs.
- Must be designed with an exterior moisture barrier or other means to prevent moisture from entering the vault.
- Must be sized to contain a release volume equal to 100 percent of the capacity of the largest enclosed tank.
- Must be designed to prevent run-on or infiltration of precipitation inside the liner or be provided with additional volume to contain precipitation from a 25-year, 24-hour storm.
- Waterstops which are chemically resistant to the waste to be stored or treated must be used at all joints (WAC 173-303-360(e)(ii)(C)). Materials frequently used for waterstops are polyvinyl chloride (PVC), high and low density polyethylene (HDPE and LDPE), polypropylene (PP), nylon and various rubber compounds.

Double-walled Tanks

Additional requirements for double-walled tanks (WAC 173-303-640(e)(iii)) are as follows:

- Must be designed as an integral structure with the inner tank being completely enclosed by the outer shell so that any release from the inner tank is entirely contained by the outer shell.
- Must be designed with a built-in continuously operating leak detection system installed between the inner and outer walls which is capable of detecting a release within 24-hours (Manufacturer-provided leak detection systems are available.)
- Metallic double-walled tanks must be provided with corrosion protection for both the interior surface of the inner tank and the exterior surface of the outer tank.

Buildings Used for Secondary Containment

A building can be used to provide secondary containment provided it is designed and installed to meet all of the requirements common to secondary containment systems. This includes constructing the building to prevent run-on or infiltration of precipitation into the building and ensuring that a sump or other containment method is large enough to contain 100 percent of the capacity of the largest tank enclosed by the building.

The portion of the building structure that is designated to provide secondary containment must also meet the following requirements:

- Must have an interior coating that is impermeable to and chemically compatible with the wastes being stored or treated within the building.
- Must be designed with an external moisture barrier or other means to prevent moisture from entering the containment area.
- Must use waterstops chemically compatible with the waste being stored or treated at all construction joints.

Variance From Secondary Containment Requirement

Secondary containment is not required for a new tank system if the owner or operator can obtain a variance from these requirements. To obtain a variance from secondary containment requirements, the owner or operator must demonstrate to Ecology that alternative design and operating practices, together with location characteristics, will be at least as effective as secondary containment in preventing the migration of dangerous waste or dangerous constituents into the ground water or surface water.

Ecology considers the following items in deciding whether to grant a variance from secondary containment requirements (WAC 173-303(4)(g)(i)):

- The nature and quantity of the wastes being stored or treated.
- Any proposed alternate design and its operation.
- The hydrogeologic setting of the tank system, including the vertical separation between the tank system and the groundwater.
- All other factors that would influence the quality and mobility of the dangerous constituents and the potential for them to migrate to ground water or surface water.

3.5 Ancillary Equipment

Tank system ancillary equipment (piping, fittings, flanges, valves and pumps) must be designed to be supported and protected against damage and excessive stress due to excessive settlement, vibration, expansion or contraction (WAC 173-303-640(3)(f). Maximum flows and any unusual operating stresses should be identified to verify that peak flows and internal stresses are within the design limits specified by the piping manufacturer.

Ancillary equipment that is not visually inspected for leaks on a daily basis must be designed and installed with secondary containment (WAC 173-303-640(4)(f). Secondary containment for ancillary equipment generally consists of trench liners, jacketing, or installing double-walled piping and fittings.

Although not specifically required in the regulations, one or more emergency shutoff and/or check valves should be included in the piping to the tank. This will provide a way to shut off the flow to the tank in the event of a sudden rupture of the tank or other emergency condition. Backup valves should also be provided for situations when it is necessary to remove or replace a valve.

Overfill prevention equipment should be installed to warn the operator and/or to shutdown transfer pumps when tank system capacity is reached. Overfill prevention equipment includes automatic shutoff controls, liquid level sensing devices and high level alarms.

3.6 Corrosion Assessment

Dangerous waste regulations require a corrosion expert to determine the factors effecting corrosion potential and corrosion protection requirements of the "external shell of a metal tank or any external metal component of the tank system (including secondary containment) which will be in direct contact with soil or water" (WAC 173-303-640(3)(a)(iii)). This assessment must be conducted by a "corrosion expert" who is certified as being qualified by the National Association of Corrosion Engineers (NACE) as a Corrosion Specialist or is a registered professional engineer who has certification or licensing that includes education and experience in corrosion control on buried or submerged metal piping systems and metal tanks" (WAC 173-303-040).

Corrosion Potential

The following items should be considered when assessing corrosion potential:

- Properties of the surrounding soil including moisture, pH, resistivity, sulfide and chloride content.
- The influence of nearby underground metal structures.
- The presence of stray electrical current from nearby electrical equipment using an external power source.
- Structure-to-soil potential.

Corrosion Protection Measures

The corrosion expert must "determine the type and degree of external corrosion protection needed to ensure the integrity of the tank system during the use of the tank system or component" (WAC 173-303-640(3)(a)(iii)(B)). Corrosion protection includes the following:

- Constructing that portion of the tank system which is in direct contact with soil or water with corrosion resistant materials such as fiberglass reinforced plastic (FRP) or a special alloy.
- Using well-drained, homogenous, crushed rock or pea gravel for backfill material. (This is to prevent "concentration cell" corrosion caused by the tank system being partially surrounded by tightly packed soils with low oxygen content adjacent to loosely packed soils with high oxygen content.)
- Using corrosion resistant coatings, such as epoxy, combined with cathodic protection.
- Installing a sacrificial anode or impressed current cathodic protection system.

Internal corrosion should also be prevented or accounted for, especially when a metallic tank system is being designed to store a highly corrosive waste (pH less than or equal to 2 or greater than or equal to 12.5). One approach is to increase the computed tank structural shell thickness by a "corrosion allowance" based on a conservatively assumed corrosion rate. For example, an assumed corrosion rate of 20 mils (0.02 inch) per year would require the calculated structural shell thickness to be increased by 1/2 inch based on a tank design life of 25 years.

Corrosion "coupons" consisting of the same material as the tank, can be installed to compare the actual corrosion rate to the assumed rate once the tank is placed in service. Periodic thickness measurements using ultrasonic equipment can also be used to estimate the actual corrosion rate.

3.7 New Tank System Design Assessment Report

A written report providing the results of the tank system design assessment must be prepared by either the independent qualified professional engineer or by another qualified person. This report must then be reviewed and certified by the professional engineer (WAC 173-303-640(3)(a). The corrosion assessment portion of the report must be conducted and signed by a "corrosion expert" (see Section 3.6).

The assessment report and certification will be used by Ecology to review the acceptability of the tank system design at facilities which are applying for a finial status permit or submitting a permit modification for the addition of a new tank system. A copy of the assessment report with the professional engineer's certification should be provided to the facility.

This report should contain the following items to adequately document the design assessment and to facilitate review by Ecology staff:

1. Site map of the facility showing the proposed location of the tank system within the overall facility.
2. A sketch of the tank system including connected piping and fittings. If there is more than one tank in the system, the individual tanks should be clearly labeled.
3. Structural design standards and criteria used with reference to applicable industry standards and recommended practice codes. All calculations for non-standard tanks, foundation design and any required anchoring should be included (see Section 3.1).
4. An assessment of the dangerous wastes to be stored or treated and their compatibility with the tank system (See Section 3.2).
5. A description and assessment of the pressure control system (if required - see Section 3.3).
6. A description and assessment of the secondary containment system (see Section 3.4).
7. An assessment of the design of ancillary equipment (see Section 3.5).
8. A determination by a corrosion expert of the corrosion potential and corrosion protection requirements for the tank system (see Section 3.6). The corrosion expert should sign and date this determination.

9. A recommended inspection schedule once the tank is placed in service based on the performance of similarly designed tank systems operating under similar conditions.
10. A statement by the professional engineer certifying that the tank system has been adequately designed. This certification must be in accordance with WAC 173-303-810(13)(a) and the professional engineer's signature and stamp must be placed below the certification statement.

Chapter 4. Inspecting Tank System Installations

Adequate tank design will not necessarily ensure proper tank installation. For this reason, dangerous waste regulations require an independent qualified installation inspector or independent qualified professional engineer to inspect a new tank system or component(s) before it is covered, enclosed or placed in use (WAC 173-303-640(3)(c)). This individual is responsible for certifying to Ecology that the tank system was properly installed (WAC 173-303-640(3)(h)).

4.1 Inspection Activities

The integrity of a tank system is determined to a great extent by the quality of the installation. The qualified independent inspector or professional engineer must assess the tank system for structural damage or inadequate construction/installation including weld breaks, punctures, damage to protective coatings, cracks and corrosion. The inspector must document measures taken to correct these or any other defects if they are discovered.

The qualified independent inspector or professional engineer or his or her representative should be present on site to observe and verify that correct materials and procedures are used for the following activities:

- Visual inspection and pressure (soap) testing;
- Subgrade and foundation preparation;
- Placement and compaction of backfill;
- Placement of reinforcing steel and anchor bolts;
- Concrete placement;
- Placement of shop-fabricated tanks;
- Erection of field-erected tanks;
- Installation of secondary containment liner or vault;
- Installation of piping, pumping and other ancillary equipment;
- Installation of cathodic protection systems; and,
- Tightness testing prior to placing tank system in service.

4.2 Tightness Testing

Dangerous waste regulations require new tanks and ancillary equipment to be tightness tested prior to being covered, enclosed or placed in use (WAC 173-303-640(3)(e)). Aboveground or on-ground tanks should be tightness tested at operating pressures using air, an inert gas or water. Underground tanks should be tested with air before they are placed in the ground or with water after they are placed in the ground. Piping should be either air tested at 110 percent of the maximum operating pressure or hydrostatically tested at 150 percent of maximum operating pressure.

Air or inert gas testing consists of pressurizing the interior of the tank and/or piping and applying a soap solution to the exterior surface. The person conducting the test then inspects for bubbles which indicates a possible leak, especially at joints and connections.

Hydrostatic testing consists of placing water or another nonhazardous liquid inside the tank and/or piping at the specified pressure and determining if a leak occurs. A leak rate greater than 0.05 gallons per hour is generally considered to be a "failed" test which indicates the tank or piping system is not tight.

If test results indicate that the tank or piping system is not tight, the source of the leak or leaks must be determined. Necessary repairs must be made and the tank system must be successfully retested before it is covered, enclosed or placed in use.

4.3 Field-Fabricated Corrosion Protection Systems

Installation of field-fabricated corrosion protection systems (typically impressed current cathodic protection systems) must be supervised by an independent corrosion expert to ensure proper installation of these systems(WAC 173-303-640(3)(g)).

4.4 Documentation of Inspection Results

A report documenting the results of the tank system installation inspection must be prepared by the installation inspector or professional engineer and given to the facility owner/operator (WAC 173-303-640(h)). This report, which must be included with the Operating Record and kept accessible at the facility, should contain the following items:

1. A site plan showing the location of the installed tank system. An as-built site plan should be used if available.
2. An as-built drawing of the installed tank system including connected piping. Individual tanks should be clearly labeled with ID numbers.

3. Inspection notes, photographs and any other material used to document inspection activities.
4. Documentation of any defects discovered in materials, equipment or installation procedures and measures taken to correct these defects (see Section 4.1).
5. Documentation of tightness testing results demonstrating the tank system is tight prior to placing it into service (see Section 4.2).
6. If a corrosion protection system is field-fabricated, a statement certifying its proper installation must be signed and dated by the corrosion expert (see Section 4.3).
7. A statement certifying the proper installation of the tank system must be signed and dated by the installation inspector or professional engineer according to WAC 173-303-810(13)(a).

Appendix A. Applicable National Standards and Practice Codes

Listed below is a brief description of industry standards and recommended practice codes, portions of which are applicable to design or integrity assessments of tank systems storing dangerous waste. Copies of a specific industry standard or recommended practice code can be obtained by contacting the organization producing the code or standard.

1. American Concrete Institute Publication 201.1R: *Guide for Making a Condition Survey for Concrete in Service.* Provides a checklist for inspecting concrete structures and includes photographs illustrating various types of concrete cracking and failures.
2. American Concrete Institute Publication 224.1R: *Causes, Evaluation and Repair of Cracks in Concrete Structures.* Provides information on causes and methods for repairing cracks in concrete.
3. American Concrete Institute Publication 350R: *Concrete Sanitary Engineering Structures.* Contains design and construction recommendations for reinforced concrete sanitary engineering structures including tanks and containment basins.
4. American National Standards Institute Standard B31.3: *Petroleum Refinery Piping.* Provides minimum requirements for design, fabrication, inspection and testing of piping systems within a facility engaged in processing or handling chemical products.
5. American National Standards Institute Standard B31.4: *Liquid Petroleum Transportation Piping System.* Provides minimum requirements for design, fabrication, inspection and testing of piping transporting liquid petroleum products.
6. American Petroleum Institute: *Guide for Inspection of Refinery Equipment, Chapter XIII, Atmospheric and Low Pressure Storage Tanks.* Covers the inspection of atmospheric storage tanks designed to operate at pressures from atmospheric through 0.5 psig and low-pressure storage tanks designed to operate at pressures from 0.5 through 15 psig.
7. American Petroleum Institute Standard 570: Piping *Inspection Code - Inspection, Repair, Alteration, and Rerating of In Service Piping Systems.* Provides minimum standards for inspection, alteration and repair of in-service piping systems.
8. American Petroleum Institute Standard 620: *Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks.* Covers the design and construction of large, welded, field-assembled aboveground steel storage tanks operated from atmospheric pressure through 15 psig.

9. American Petroleum Institute Standard 650: *Welded Steel Tanks for Oil Storage.* Provides minimum standards for design, fabrication, erection and testing of vertical, cylindrical, closed and open top welded steel aboveground storage tanks.

10. American Petroleum Institute Standard 651: *Cathodic Protection of Aboveground Petroleum Storage Tanks.* Presents procedures and practices for achieving effective corrosion control on aboveground storage tank bottoms through the use of cathodic protection.

11. American Petroleum Institute Standard 653: *Tank Inspection, Repair Alteration and Reconstruction.* Provides minimum standards for maintenance, inspection, repair, alteration, relocation and reconstruction of non-refrigerated, atmospheric pressure carbon and low alloy steel aboveground tanks built to API Standard 650.

12. American Petroleum Institute Standard 1615: *Installation of Underground Petroleum Storage Systems.* Provides procedures and equipment that should be used for underground petroleum storage systems. Provides guidelines for design and installation of underground piping systems.

13. American Petroleum Institute Standard 1632: *Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems.* Contains guidelines for providing corrosion protection for belowground portions of tanks and piping.

14. American Petroleum Institute Standard 2000: *Venting Atmospheric and Low Pressure Storage Tanks.* Provides requirements for normal and emergency venting for aboveground tanks design to operate from 1/2 oz. per sq. in. vacuum through 15 psig pressure.

15. American Petroleum Institute Standard 2350: *Overfill protection for Petroleum Storage Tanks.* Includes discussion of manual and automatic systems used to prevent tank overfills.

16. Environmental Protection Agency publication EPA/530-SW-86-044: *Technical Resource Document for the Storage and Treatment of Hazardous Waste in Tank Systems.* Provides EPA guidance on minimum technical requirements for hazardous waste storage tanks for persons preparing and reviewing Part B permit applications.

17. Environmental Protection Agency publication EPA/530-R-93-005: *Determining the Integrity of Concrete Sumps.* Provides methods for assessing the structural integrity of concrete sumps and vaults storing dangerous waste and information on concrete repair and protective coatings.

18. National Association of Corrosion Engineers Recommended Practice RP-02-85: *Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems.* Contains guidelines for providing and evaluating corrosion protection on belowground portions of tanks and piping.

19. National Association of Corrosion Engineers Standard Recommended Practice RP0169-92: *Control of External Corrosion on Underground or Submerged Metallic Piping Systems.* Contains guidelines for providing and evaluating corrosion control on belowground metallic piping.

20. National Association of Corrosion Engineers Standard RP0193-93: *External Cathodic Protection of On-Grade Metallic Storage Tank Bottoms.* Provides guidelines for the design, installation and maintenance of cathodic protection systems for the exterior bottoms of on-grade metallic storage tanks.

21. National Fire Protection Association (NFPA) 30: *Flammable and Combustible Liquids Code.* Chapter 2 provides specific guidelines for design of secondary containment around tanks by diking.

22. Portland Cement Association. *Effects of Substances on Concrete and Guide to Protective Treatments.* Describes the various types of protective treatments used to protect concrete against chemical attack. Table in publication lists various types of chemicals, their effect on concrete and the recommended treatments to counteract these effects.

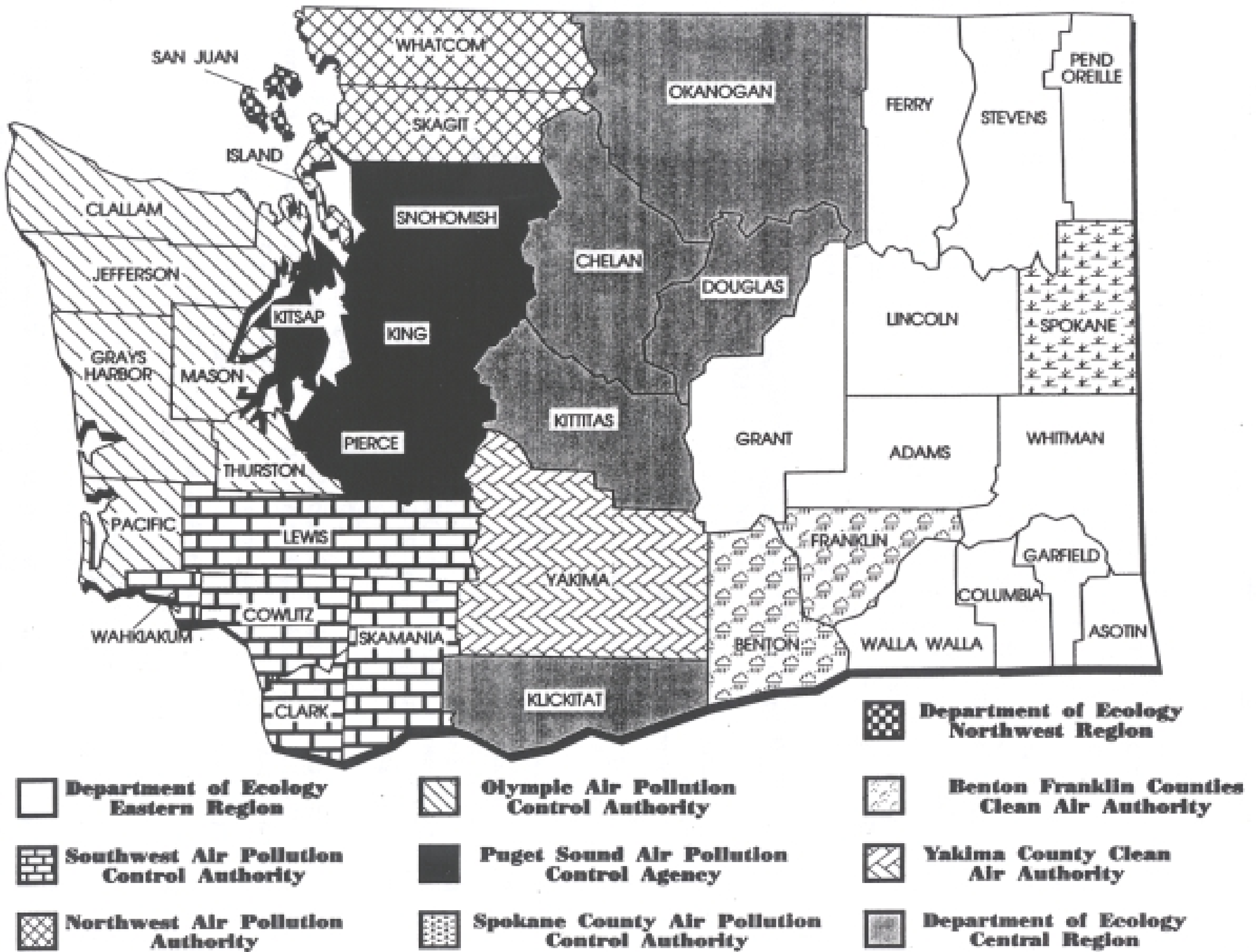
23. Steel Tank Institute: *Standard For Dual Wall Underground Steel Storage Tanks.* Addresses the manufacture, inspection and testing of dual wall steel tanks prior to shipment.

24. Underwriter's Laboratories, Standard 58: *Steel Underground Tanks for Flammable and Combustible Liquids.* Provides requirements for shop-fabricated horizontal atmospheric-type cylindrical steel tanks for underground storage of flammable and combustible liquids.

25. Underwriter's Laboratories, Standard 142: *Steel Aboveground Tanks for Flammable and Combustible Liquids.* Provides requirements for shop-fabricated horizontal and vertical welded steel tanks for aboveground storage of stable, noncorrosive liquids with a specific gravity less than or equal to water.

26. Washington Department of Ecology: *Tank Owner/Operator's Guide to Tightness Testing.* Provides guidance on tightness testing of underground storage tanks. Although written primarily for persons complying with Ecology's Underground Storage Tank regulations, portions of this publication are applicable for tightness testing of underground tanks storing dangerous wastes.

Local Air Pollution Control Authorities



LAPCA1.CDR

Sources of Information about Air Pollution in Washington

Inquiries concerning statewide regulation of air pollution should be directed to the State Department of Ecology:

State Department of Ecology
Air Quality Program
PO Box 47600, Olympia, WA 98504-7600
Telephone: (206) 407-6800 (*SCAN*: 407-6800)
Fax: (206) 407-6802, *TDD*: (206) 407-6006

Pulp Mills, Aluminum Smelters Industrial Section
PO Box 47600, Olympia, WA 98504-7600
Telephone: (206) 407-6916 (*SCAN*: 407-6800)
Fax: (206) 407-6902

Central Regional Office
(Chelan, Douglas, Kittitas, Klickitat, Okanogan Counties)
106 South 6th Avenue
Yakima, WA 98902-3387
Telephone: (509)575-2490 (*SCAN:* 558-2490)
Fax: (509) 575-2809 *TDD:(*509) 454-7673

Southwest Regional Office
PO Box 47775, Olympia, WA 98504-7775
Telephone: (206) 407-6326 (*SCAN*: 407-6326)
Fax: (206) 407-6305 *TDD*:(206)407-6306

Northwest Regional Office
(San Juan County)
3190-160th Avenue SE, Bellevue, WA 98008-5452
Telephone: (206) 649-7000 (*SCAN*: 354-7000)
Fax: (206) 649-7098 *TDD*:(206)649-4259

Eastern Regional Office
(Adams, Asotin, Columbia, Garfield, Grant, Ferry, Lincoln, Pend Oreille, Stevens, Walla Walla, Whitman Counties)
N 4601 Monroe Street, Suite 100
Spokane WA 99205-1295
Telephone: (509) 456-3114 (*SCAN*: 545-3114)
Fax: (509)456-6175 *TDD*:(509)458-2055

Inquiries concerning regional air pollution control affairs in the listed counties should be addressed to these offices:

Western Washington

Puget Sound Air Pollution Control Agency
(King, Kitsap, Pierce, Snohomish Counties)
110 Union Street, Suite 500, Seattle, WA 98101-2038
Art Davidson, Acting Air Pollution Control Officer
Telephone: (206) 343-8800 or 1-800-552-3565
Fax: (206) 343-7522

Northwest Air Pollution Authority
(Island, Skagit, Whatcom Counties)
302 Pine Street #207, Mt Vernon, WA 98273-3852
Terryl Nyman, Air Pollution Control Officer
Telephone: (206) 428-1617 (SCAN: 542-1617)
Telephone: 1-800-622-4627(Island & Whatcom)
Fax: (206) 428-1620

Olympic Air Pollution Control Authority
(Clallam, Grays Harbor, Jefferson, Mason, Pacific, Thurston Counties)
909 Sleater-Kinney Road SE, Suite 1
Lacey WA 98503-1128
Charles E. Peace, Air Pollution Control Officer
Telephone: (206) 438-8768 or 1-800-422-5623
Fax: (206) 491-6308

Southwest Air Pollution Control Authority
(Clark, Cowlitz, Lewis, Skamania, Wahkiakum Counties)
1308 NE 134th Street, Suite A
Vancouver, WA 98685-2747
Robert Elliot, Director
Telephone: (206) 574-3058 or 1-800-633-0709
(*SCAN*: 299-6092)
Fax: (206) 576-0925

Eastern Washington

Spokane County Air Pollution Control Authority
W 1101 College Ave, Suite 403, Spokane, WA 99201
Eric Skelton, Director
Telephone: (509) 456-4727 (*SCAN*: 272-4727)
Fax: (509) 459-6828

Yakima County Clean Air Authority
6 South 2nd Street, Room 1016, Yakima, WA 98901
Tom Silva, Director
Telephone: (509) 575-4116 (*SCAN*: 665-4116)
Fax: (509) 454-6954

Benton Franklin Counties Clean Air Authority
650 George Washington Way, Richland, WA 99352
Dave Lauer, Director
Telephone: (509) 943-3396 (*SCAN*: 526-2354)
Fax: (509) 943-0505 or 943-2232
Telephone: (509) 946-4489 (*Burn Ban Recording*)

If you have special accommodation needs, please contact Ecology's Air Quality Program at (206) 407-6832 (Voice) or (206) 407-6006 (TDD)

Publication # 93-106